

CMC Control Surface Designs, Phase I

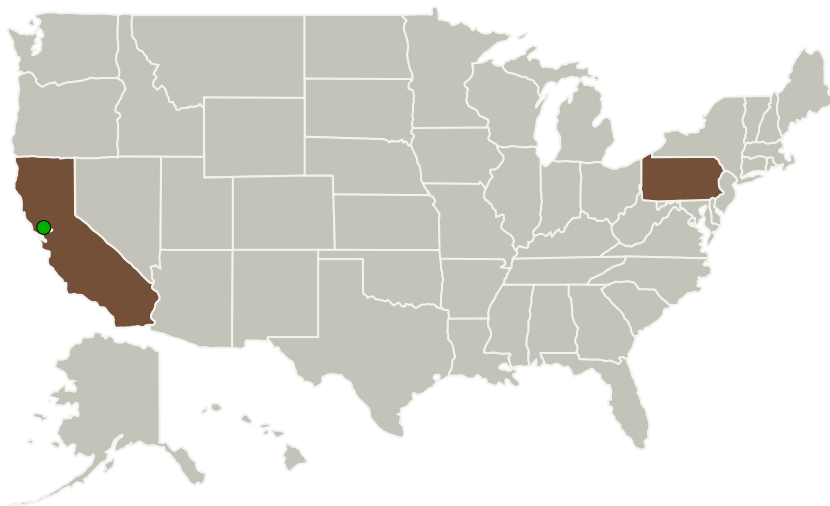
Completed Technology Project (2011 - 2011)



Project Introduction

As space exploration and hypersonic cruise technologies develop, the focus has shifted towards the development of lightweight, fully reusable and lower cost vehicles. The current state-of-the-art (SOA) is taking an incremental improvement step over the Space Shuttle TPS approach. All-ceramic matrix composite (CMC) body flaps developed for the X-38 vehicle were shown to offer considerable mass savings as well as increased durability and impact resistance. The next step in advancing the state of the art is to increase the confidence in the design and manufacturing quality of a full CMC control surface for hypersonic vehicles. Within this effort, Materials Research & Design (MR&D) is proposing a trade study which will investigate various control surface manufacturing and material options for the ruddervator design of X-37B Orbital Test Vehicle. For the proposed Phase I program, MR&D has chosen an integrally fabricated all-CMC control surface, a mechanically fastened-individually fabricated fully-CMC control surface, and a CMC sandwich structure control surface to be the three candidate design structures in a trade study. Potential material candidates include, but may not be limited to, CVI C/SiC, C-C with 1-2 SiC cycles for oxidation protection, S200 Nicalon/SiNC from ATK COIC, and SiC/SiC.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Materials Research and Design, Inc.	Lead Organization	Industry	Wayne, Pennsylvania
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Pennsylvania

Project Transitions

▶ **February 2011:** Project Start

✓ **September 2011:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138039>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Materials Research and Design, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

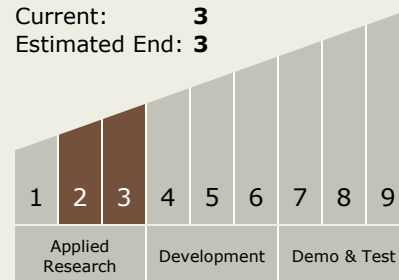
Craig Iwano

Technology Maturity (TRL)

Start: 2

Current: 3

Estimated End: 3



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Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.3 Thermal Protection Components and Systems
 - └ TX14.3.3 Thermal Protection Analysis

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System